



# **Armed Forces College of Medicine AFCM**

Anatomy Department/  
Cardiopulmonary Module/Prof Azza  
Kamal



# **THE THORACIC WALL**

## **Thoracic cage, Joints & Intercostal Muscles**

### **By**

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Anatomy Department/  
Cardiopulmonary Module/Prof  
Azza Kamal

# ILOs



- ❑ **Outline** the thoracic cage, costal margin, thoracic inlet & outlet.
- ❑ Differentiate between true, false and floating ribs.
- ❑ Correlate the thoracic cage to its traumatic injury as in fractured ribs
- ❑ Identify the joints of the thoracic cage, the type of each joint and the possible movements.
- ❑ **Demonstrate** the anatomical basis of counting ribs.
- ❑ **Describe** the arrangement, direction of

# **KEY POINTS OF THE LECTURE**

- 1) Thoracic inlet & thoracic outlet**
- 2) Joints of thoracic cage: types and movements**
- 3) Intercostal muscles: arrangement, direction of fibers, nerve supply & actions**

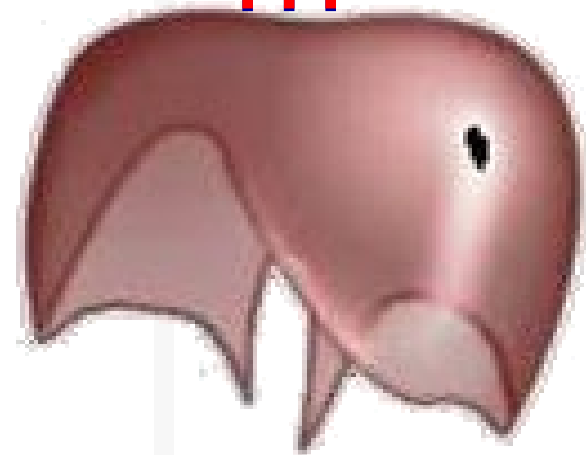




**THORAX**

**ABDOMEN**

**Diaphragm**



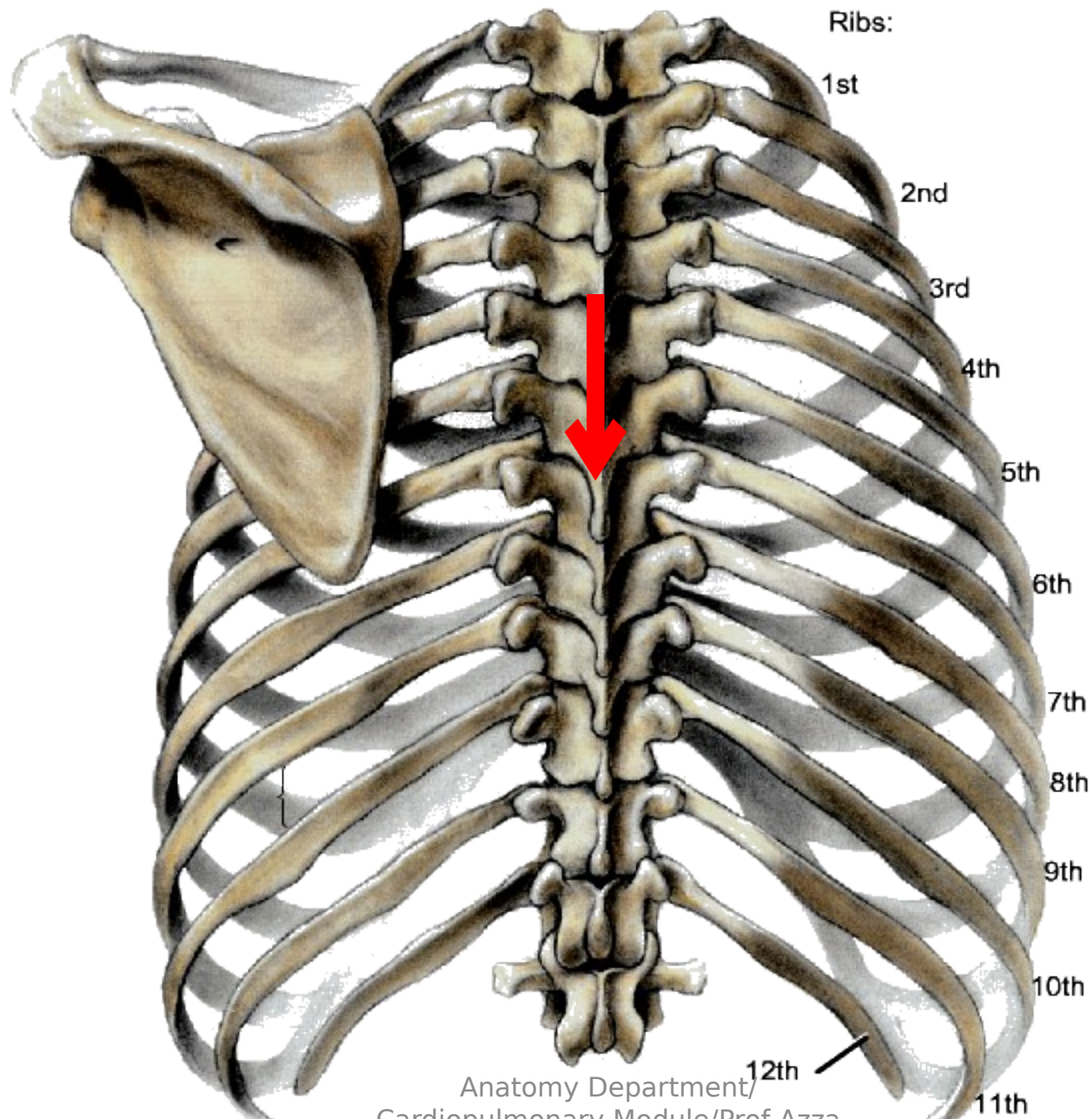


**Thoracic  
vertebrae**

**Sternum**

**Ribs**

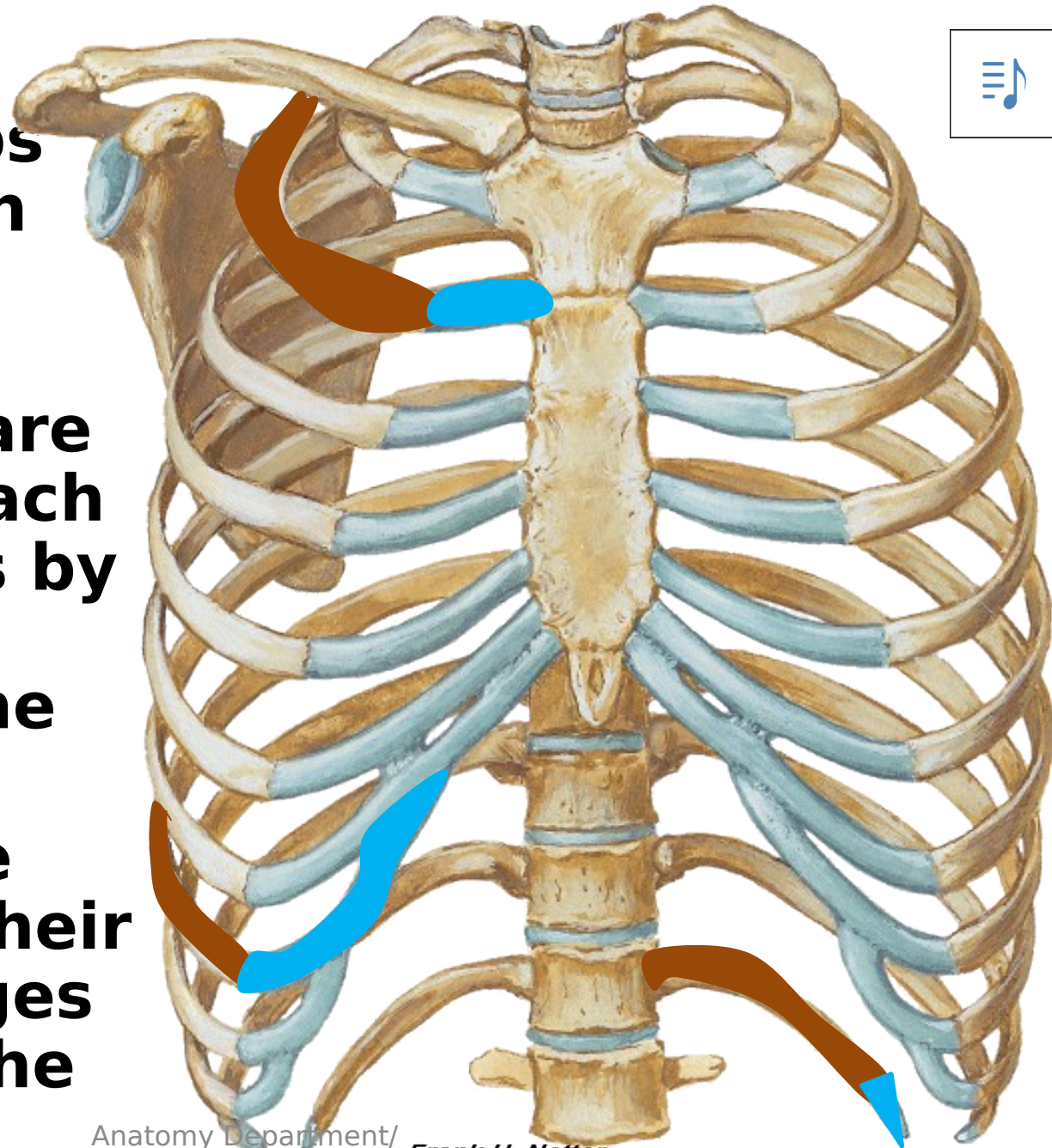
# ***Thoracic Cage***



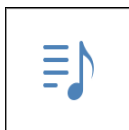
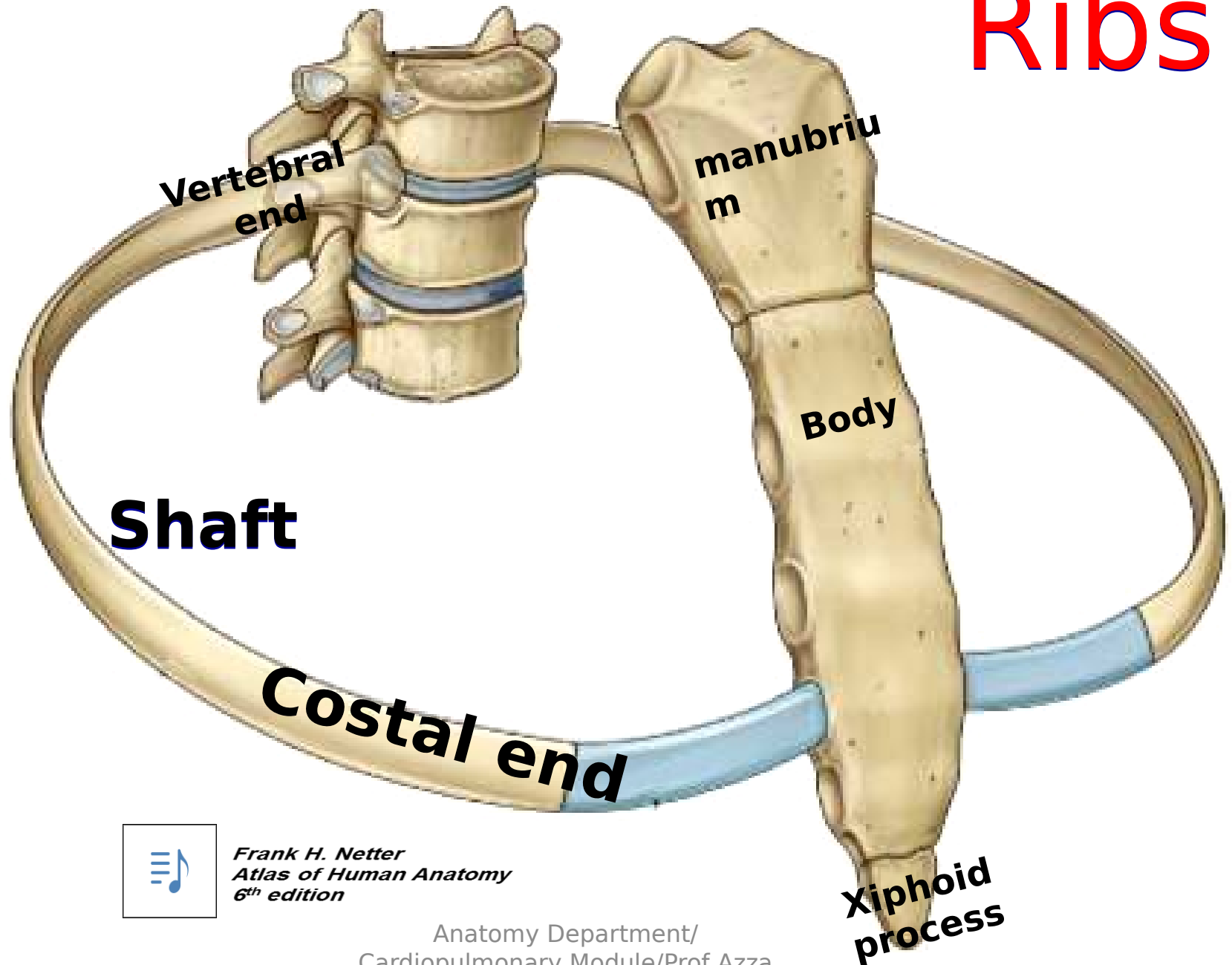


# The Ribs

- **12 pairs** of ribs articulate with the thoracic vertebrae
- **Upper seven** are **true ribs** as each rib articulates by its costal cartilage to the sternum
- **Lower five** are **false ribs** as their costal cartilages fail to reach the sternum
- **Last two** are



# Ribs



*Frank H. Netter*  
*Atlas of Human Anatomy*  
*6th edition*

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Vertebral end

Head

Neck



Upper border of costal groove

Intercostal

Lower border of costal groove

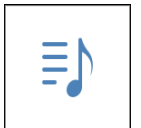
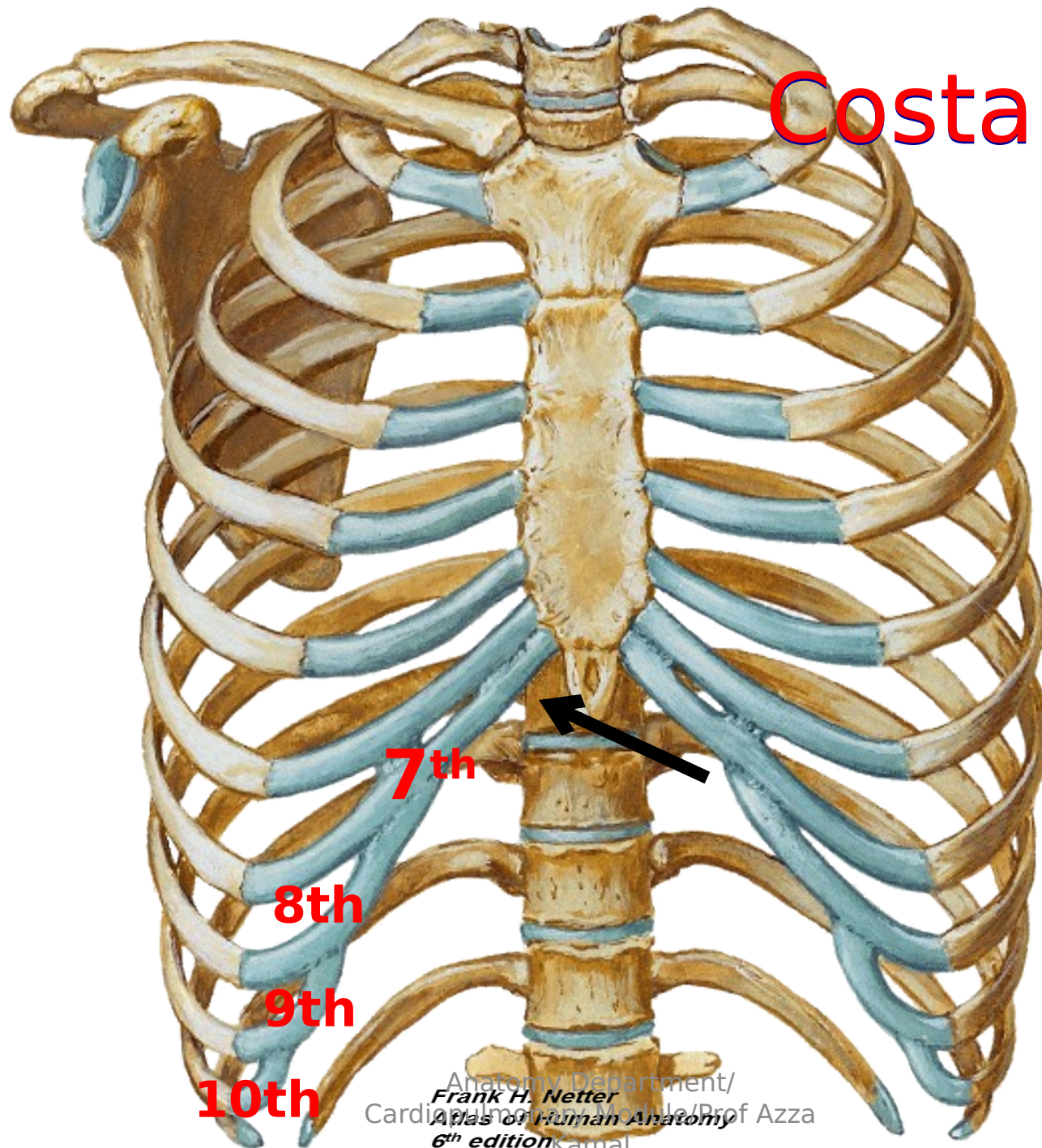
Lower border

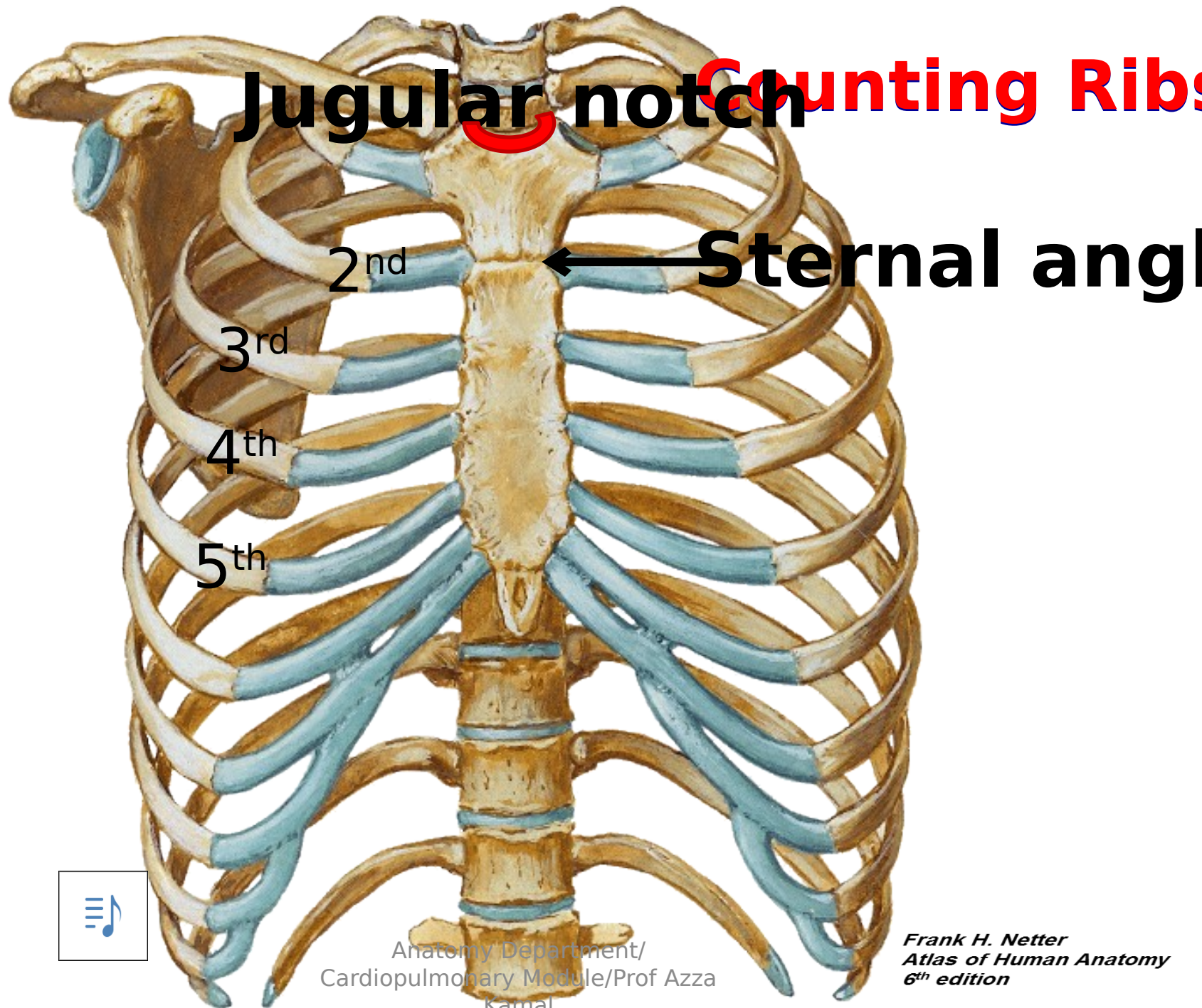
Costal end

Costal groove



# Costal margin







# Thoracic inlet

1<sup>st</sup> thoracic vertebra

1<sup>st</sup> rib

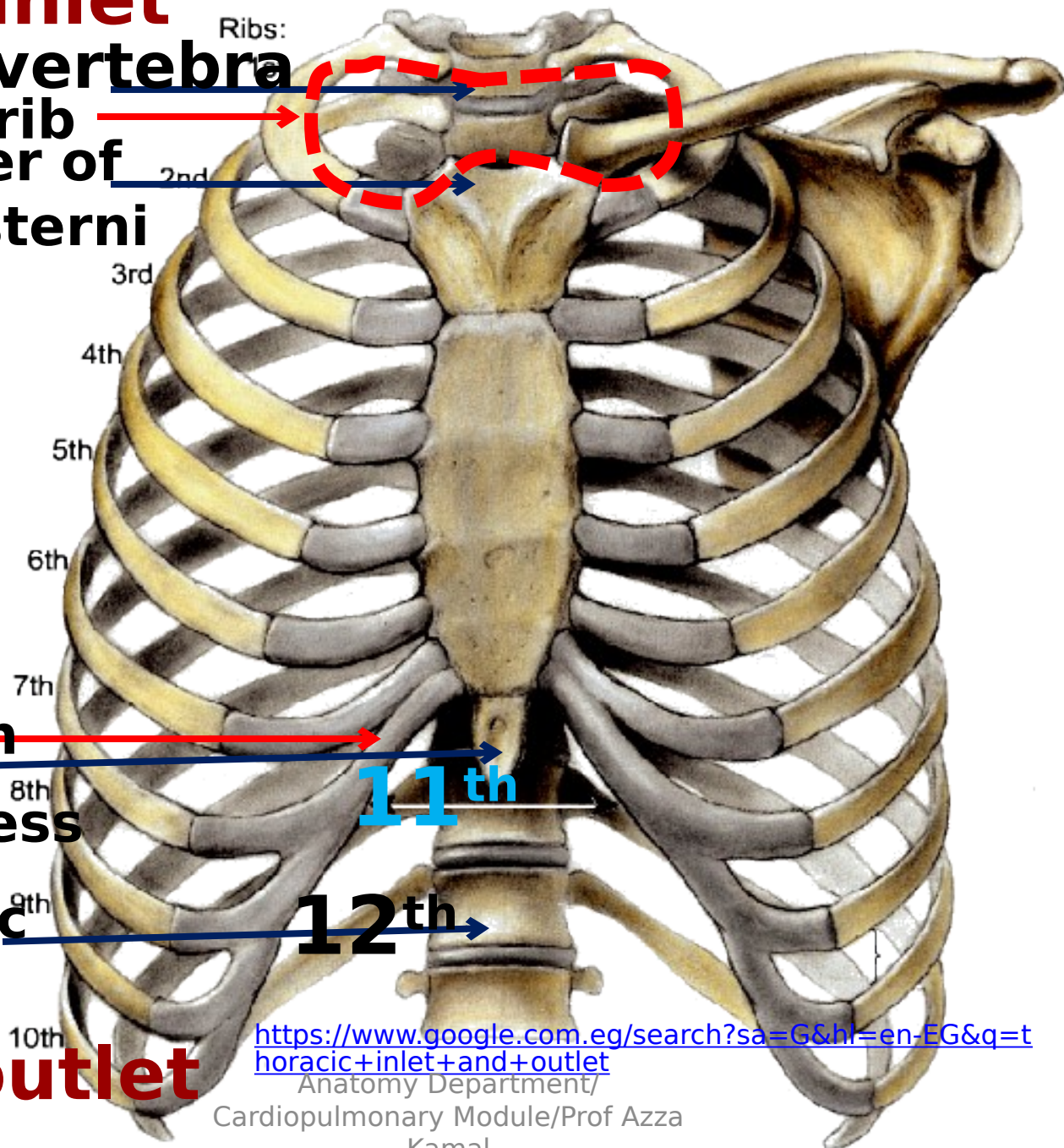
Upper border of  
Manubrium sterni

Costal margin

Xiphoid process

12<sup>th</sup> Thoracic  
vertebra

# Thoracic outlet



**The following are the bones forming the thoracic inlet, Except:**

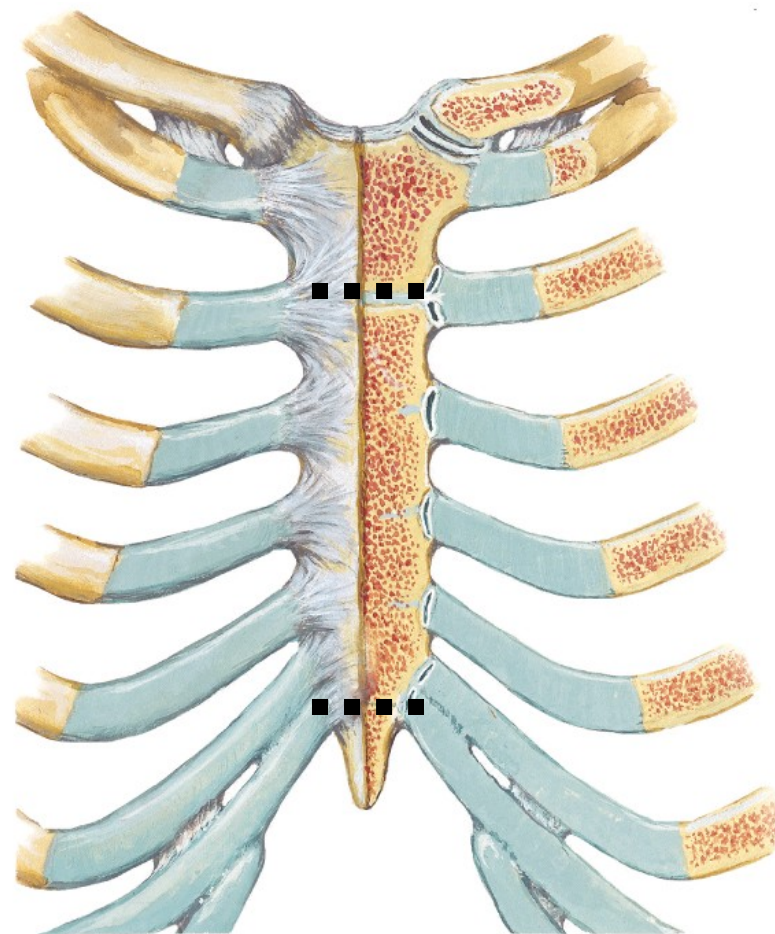
- A) First rib**
- B) First thoracic vertebra**
- C) Upper border of manubrium sterni**
- ☒ D) Sternal angle**

MCQ tests thoracic inlet & thoracic outlet



# Sternal joints

- Mid line joints are 2ry cartilagenous joints
- Manubriosternal & xiphisternal joints are both 2ry cartilaginous joints
- May become ossified at old



Frank H. Netter  
Atlas of Human Anatomy  
6th edition

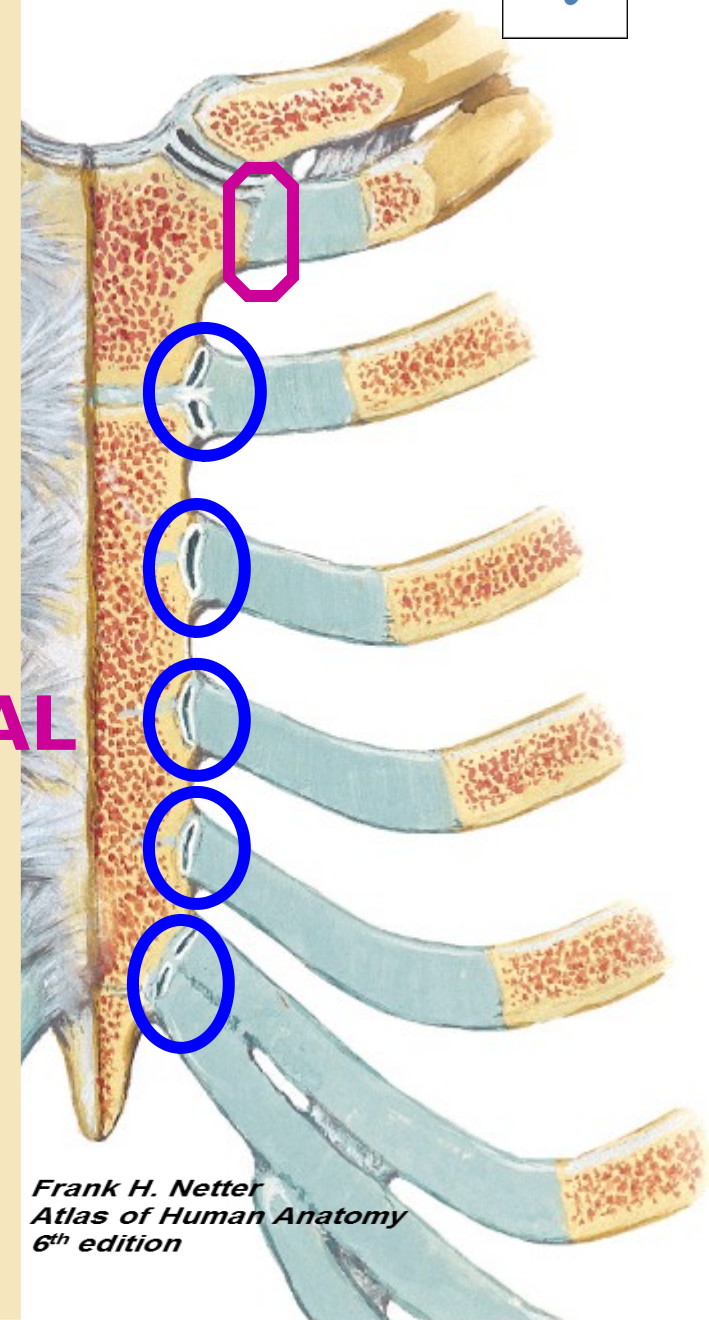


# Sternocostal joints:

## Plane synovial joints

between costal cartilages of true ribs & notches on lateral border of sternum

**EXCEPT FIRST STERNOCOSTAL JOINT □ SYNARTHROSES Or PRIMARY CARTILAGINOUS**  
(direct union between 1<sup>st</sup> costal cartilage & manubrium sterni)

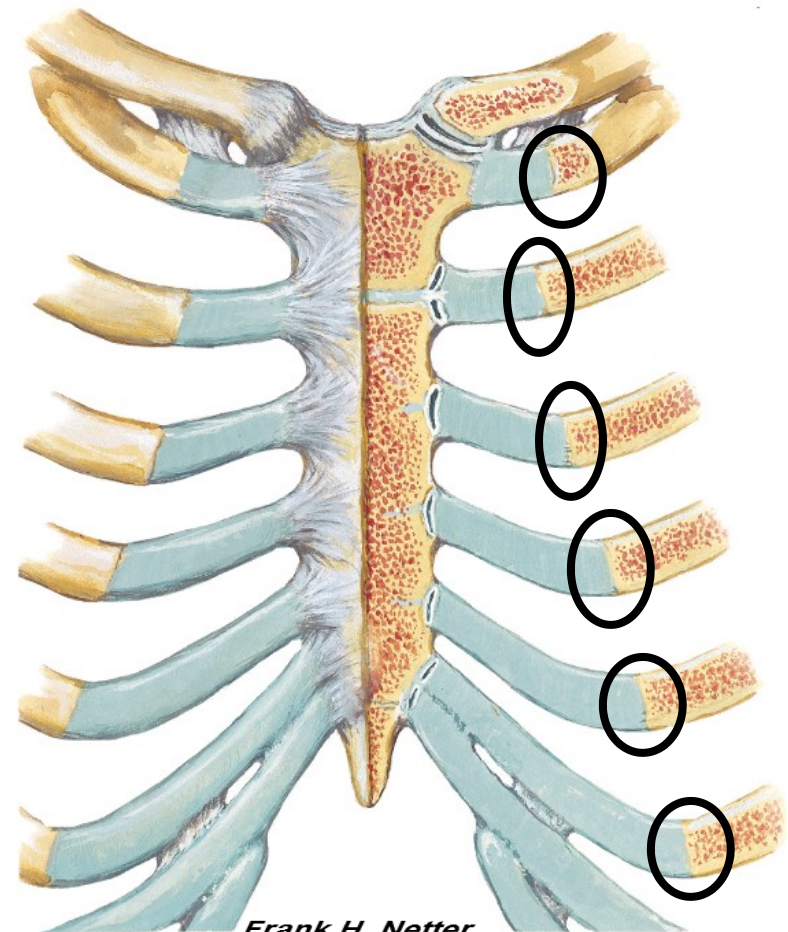


*Frank H. Netter  
Atlas of Human Anatomy  
6<sup>th</sup> edition*





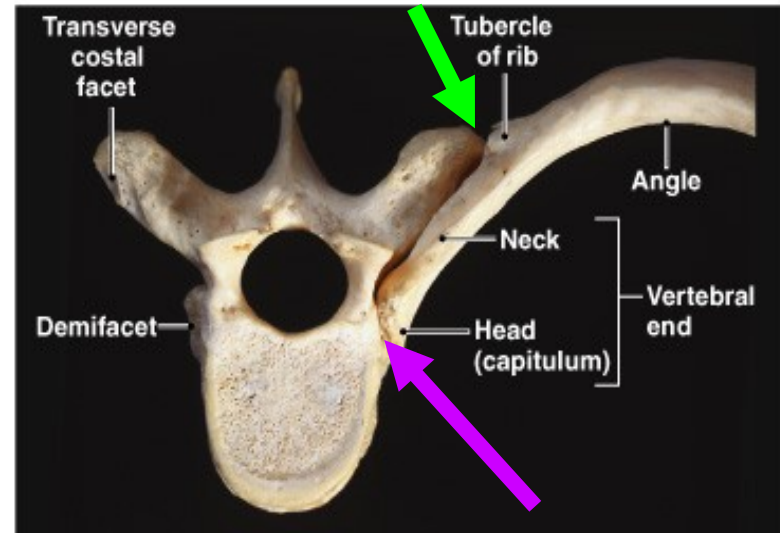
- **Costochondral joints:**
- **Between anterior ends of ribs & corresponding costal cartilages** ☐  
**1ry cartilaginous joints** ☐  
**(synarthroses)** ☐  
**NO MOVEMENT**  
**ALLOWED**



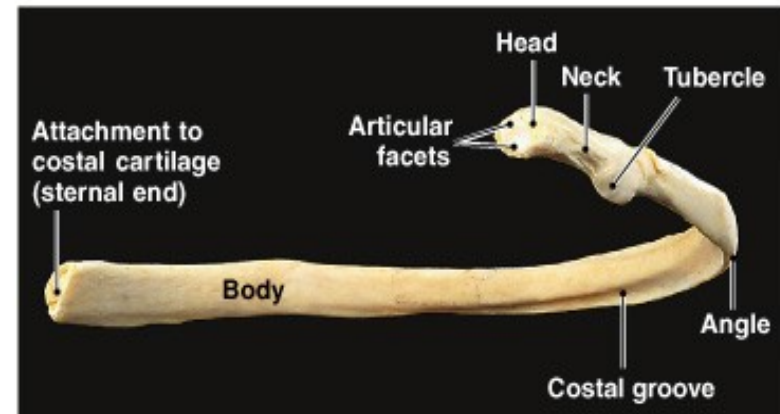
*Frank H. Netter  
Atlas of Human Anatomy  
6<sup>th</sup> edition*

# Articulation of vertebra to rib

- **Head** of rib articulates with **Body** of vertebra
- **Tubercle** of rib articulates with **Transverse process** of vertebra



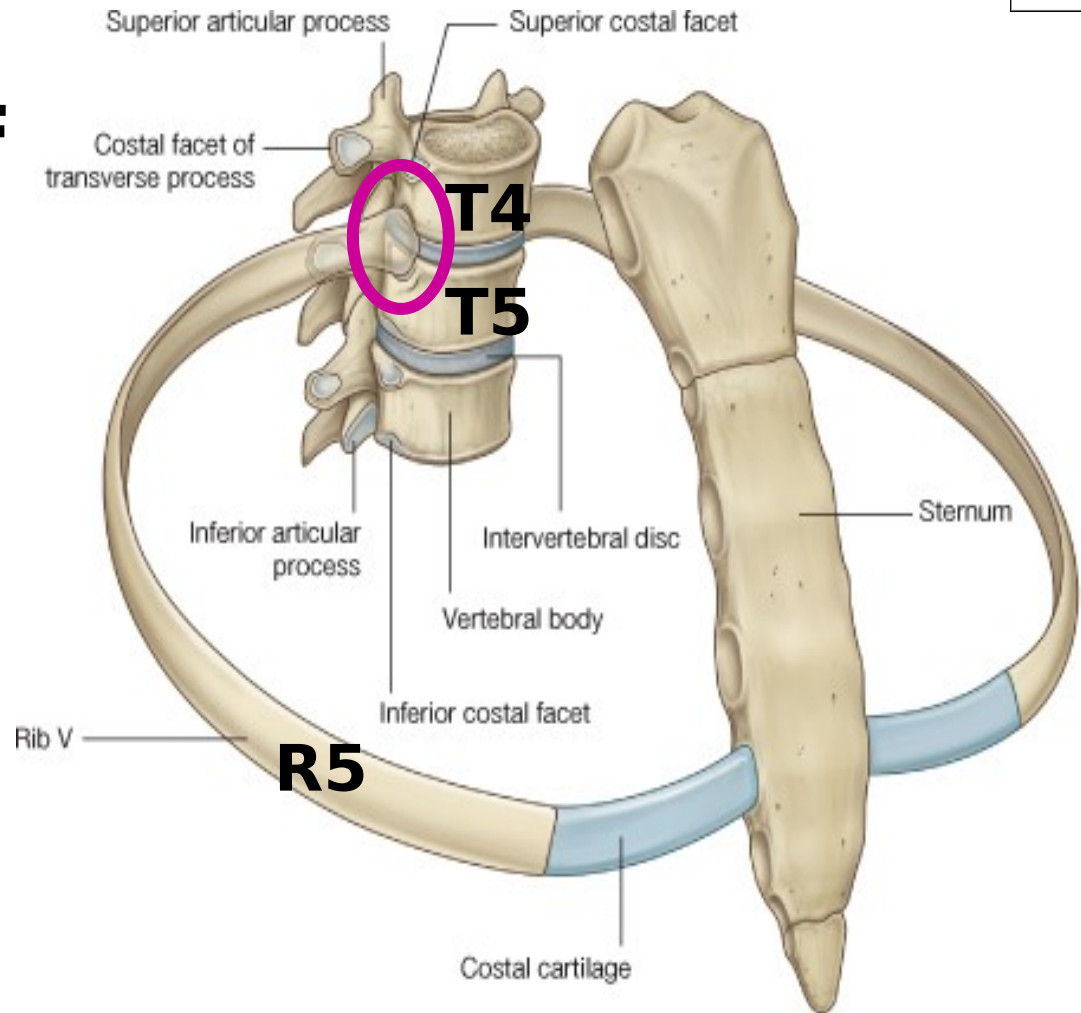
(a) Superior view





(b) Posterior view

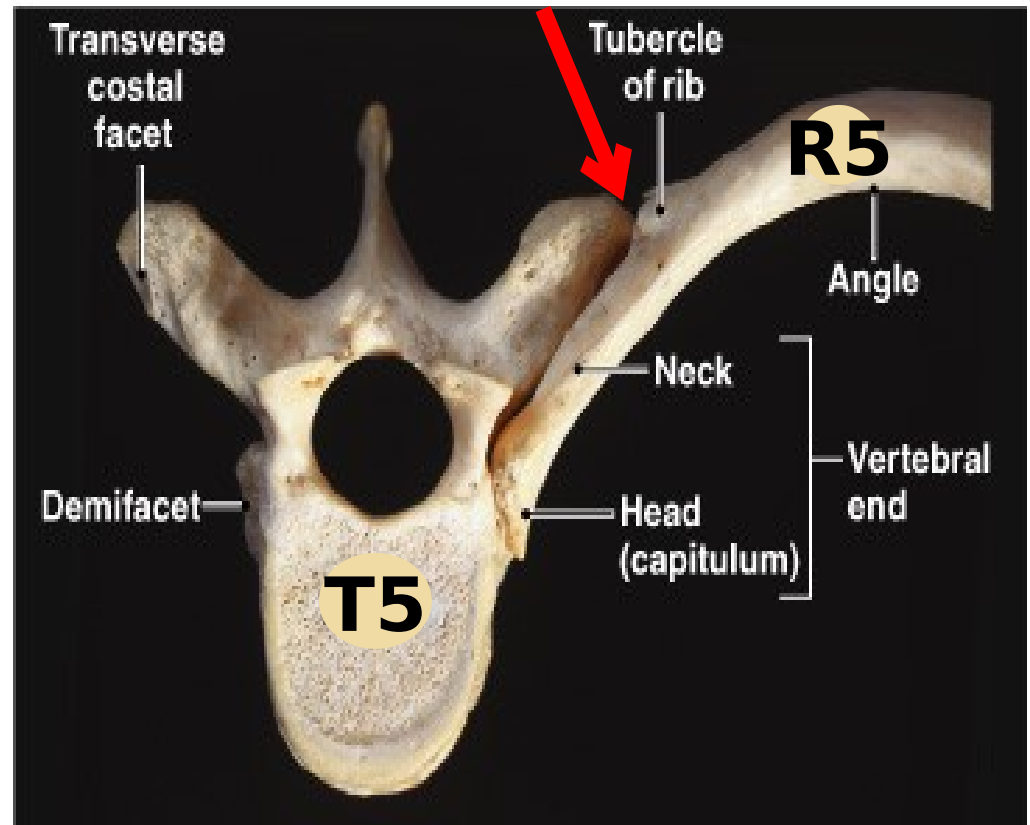
# Costovertebral joints

- **Demifacets on heads of typical ribs articulate with demifacets on bodies of thoracic vertebrae in plane**



# Costotransverse joints

- Between **t**tubercles of ribs & **t**ransverse processes of vertebrae of same number   
**PLANE**   
**SYNOVIAL**  
**JOINTS**



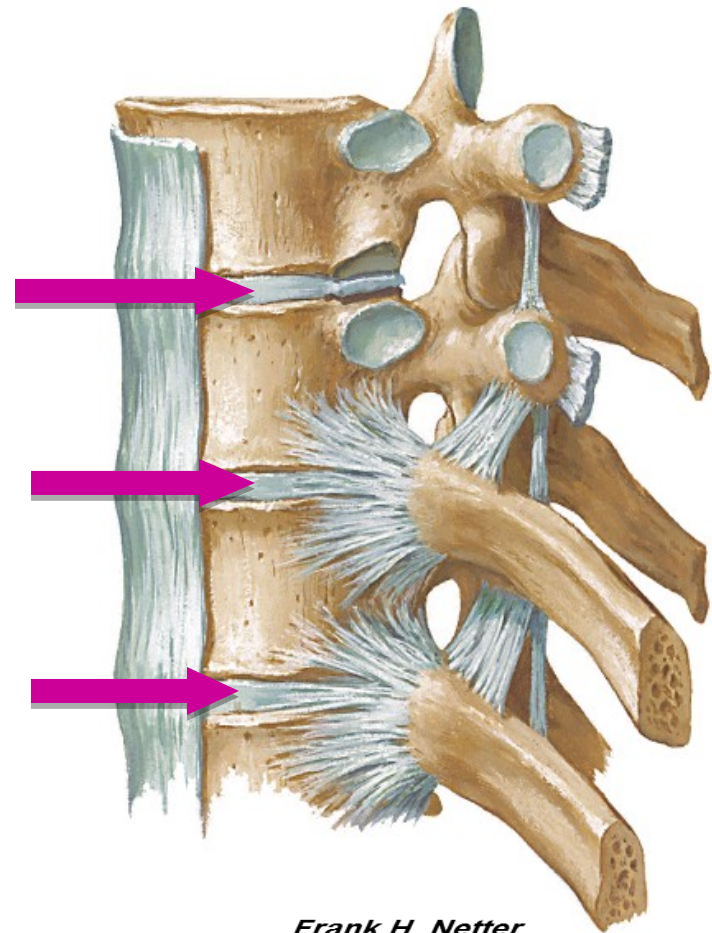
(a) Superior view



# Joints of vertebral bodies




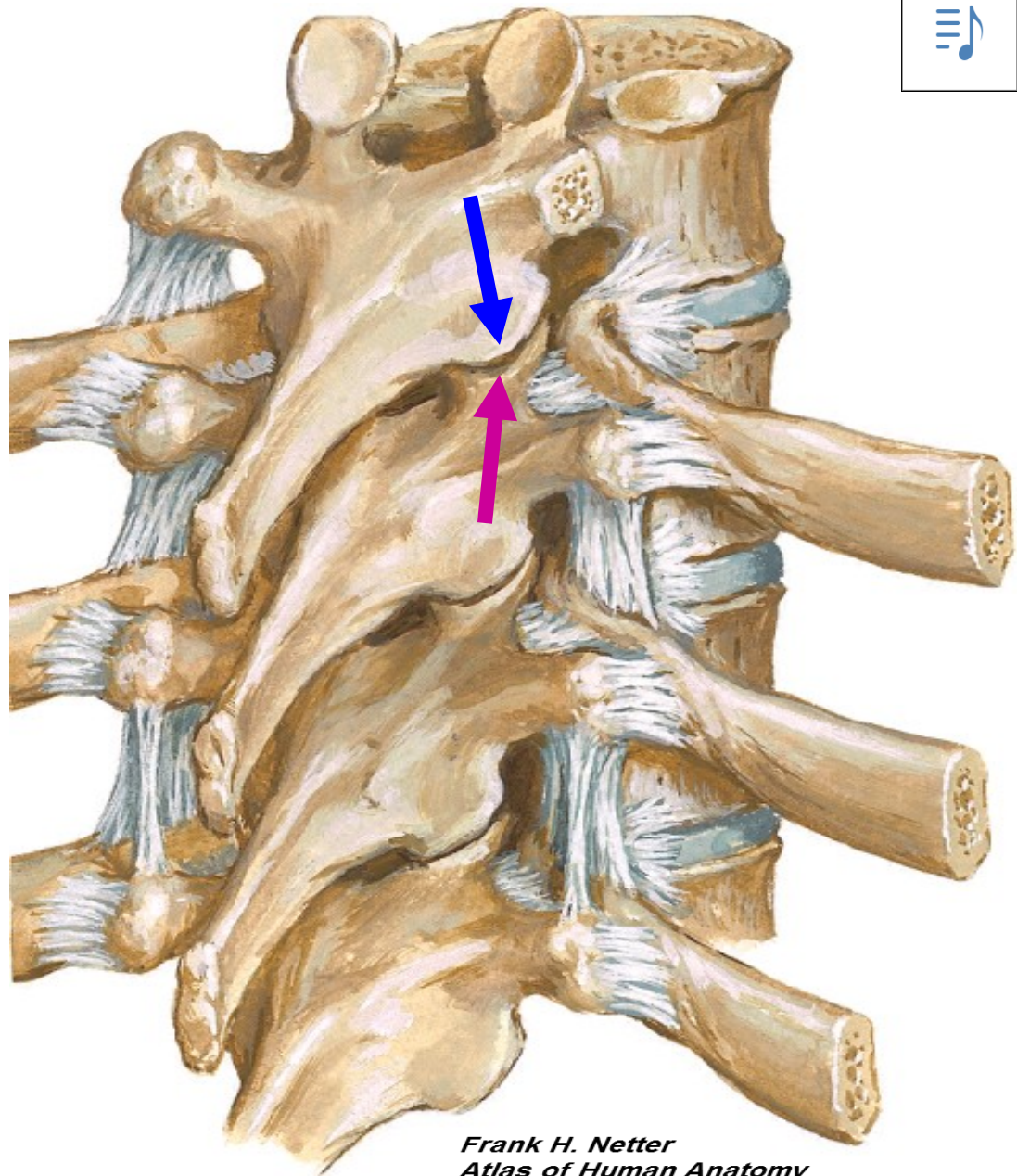
- Bodies of thoracic vertebrae are connected by intervertebral discs – 2ry cartilaginous joints
- **Midline Joints**



*Frank H. Netter  
Atlas of Human Anatomy  
6<sup>th</sup> edition*



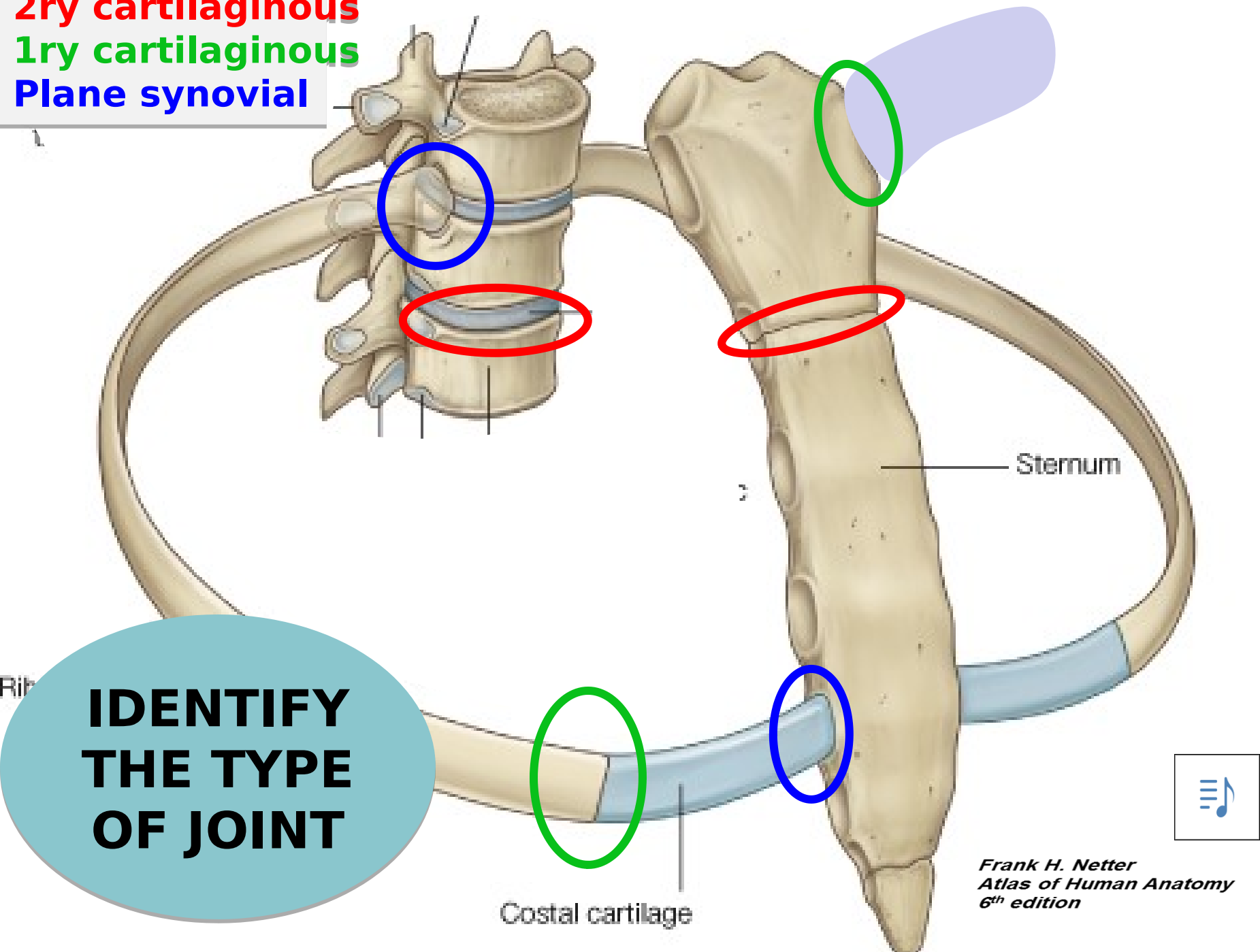
- **Inferior articular facets of vertebra above articulate with superior articular facets of vertebra below** 
- plane**



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2ry cartilaginous  
1ry cartilaginous  
Plane synovial



**IDENTIFY  
THE TYPE  
OF JOINT**

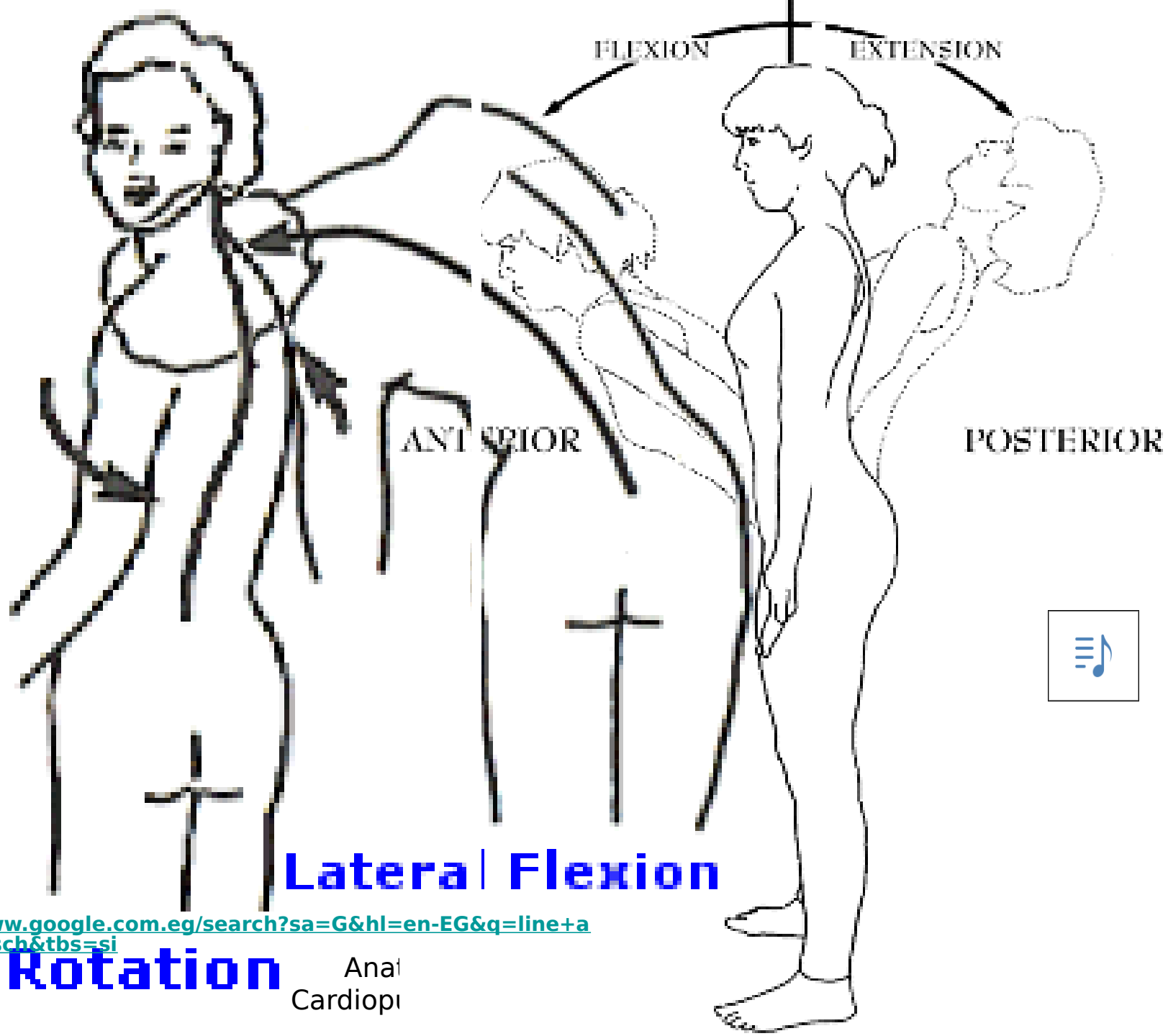


Frank H. Netter  
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6th edition

# Movements of joints of the thorax

- **Thoracic vertebrae can do:**
  1. Flexion
  2. Extension
  3. Lateral flexion
  4. Rotation
- **Joints between vertebrae & ribs** can do slight gliding movements only
- **Sternocostal joints** allow limited degree of gliding movement
- **Joints between ribs & costal cartilages** allow no movement





<https://www.google.com/search?sa=G&hl=en-EG&q=line+art&tbm=isch&tbs=si>

**Rotation**

Ana  
Cardiop



**Which of the following joints of the thoracic cage allows NO MOVEMENT?**

- A) Sternocostal**
- B) Costovertebral**
- C) Costotransverse**
- ☒ D) Between rib and costal cartilage**
- E) Intervertebral**

**MCQ tests movements of joints of thoracic cage**

# Important Clinical Notes



- ❑ **Traumatic injury to the thorax is common especially in car accidents.**
- ❑ **In children** the ribs are elastic ❑ rarely fractured
- ❑ **In adults** ❑ ribs tend to break in their weakest point ( angle of rib )
- ❑ **1<sup>st</sup> & 2<sup>nd</sup> ribs** are protected by the clavicle & pectoralis major .
- ❑ **Last 2 ribs** are floating ❑ rarely





❑ **In severe crush injuries**, a number of ribs maybe fractured .

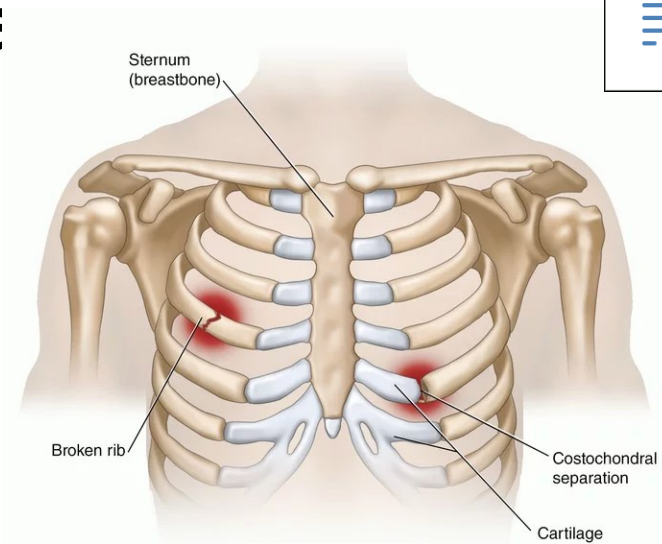
❑ The fracture may be at the angle of rib or near the costochondral junction

❑ **flail chest**

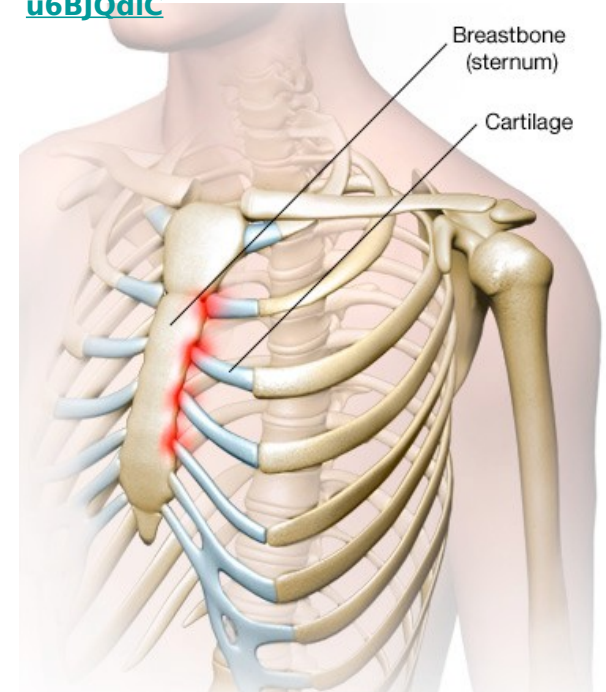
❑ Fracture on either side of the sternum

**flail sternum**

**In both cases the stability of chest wall is lost and the flail segment is sucked in with inspiration and out with expiration**



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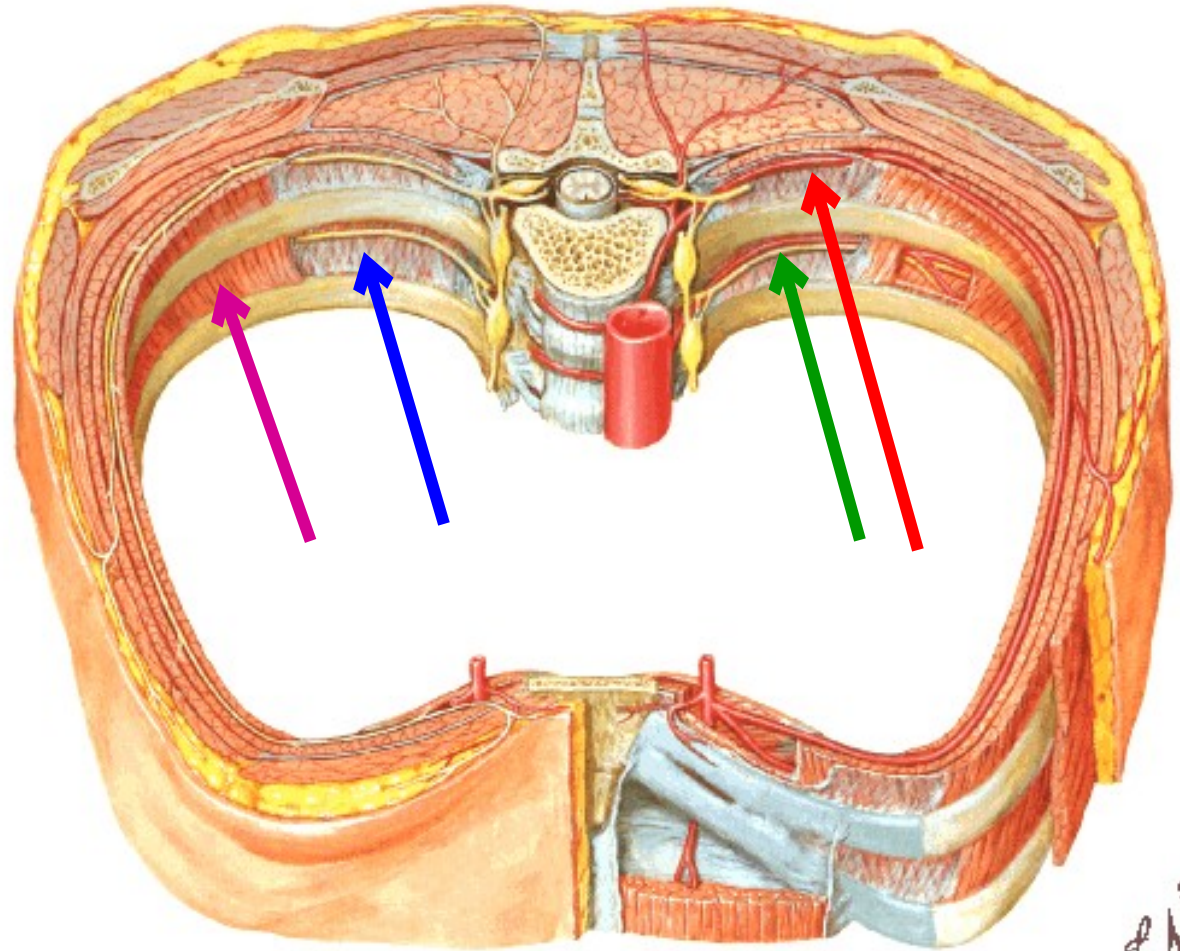
[https://lh3.googleusercontent.com/M\\_GS113](https://lh3.googleusercontent.com/M_GS113)



# Thoracic Wall



- Formed by the thoracic cage + the soft tissues which occupy the intercostal spaces
- Intercostal muscles, membranes, nerves & vessels



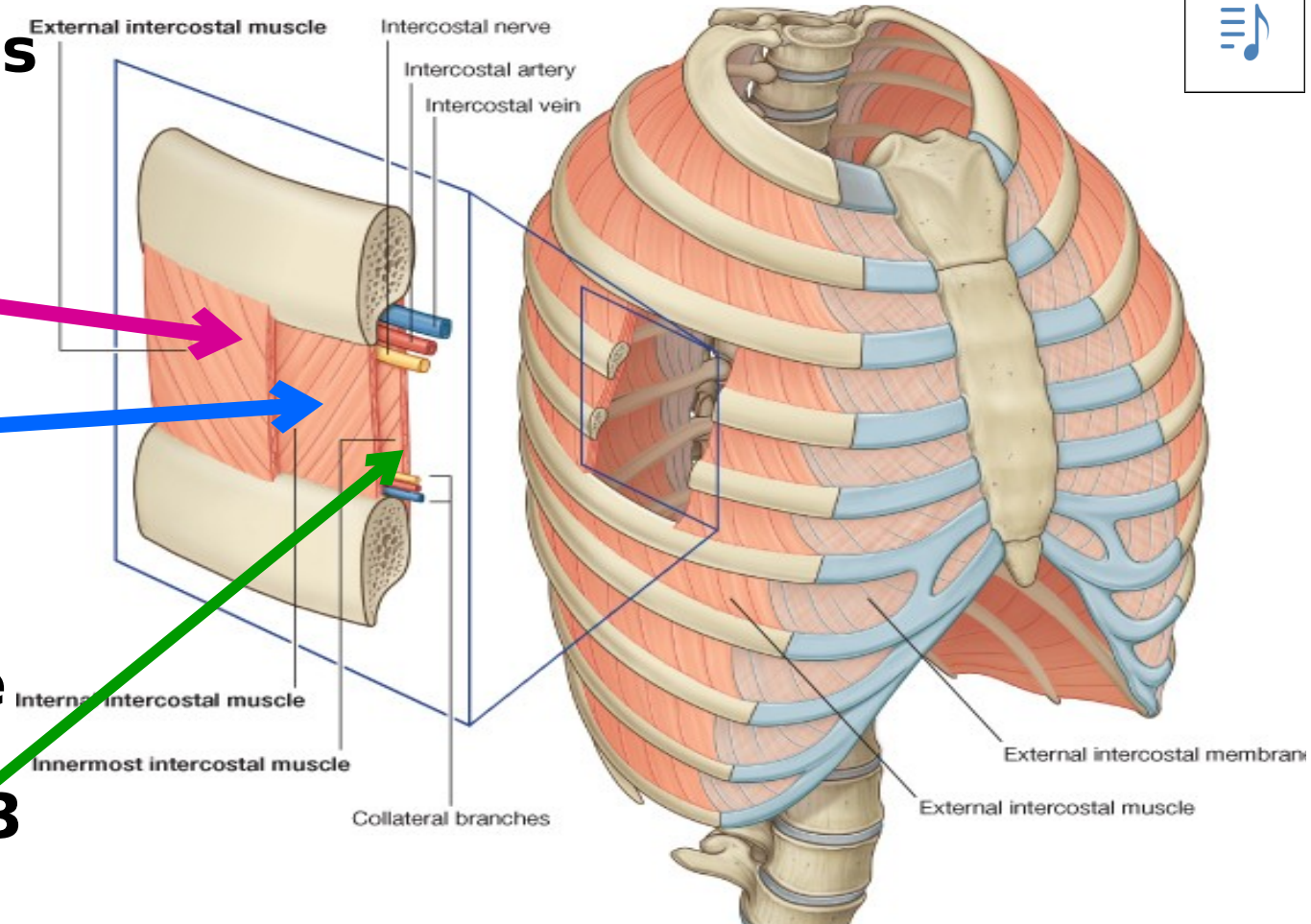
Frank H. Netter  
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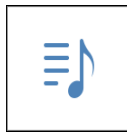
# Intercostal muscles and membranes



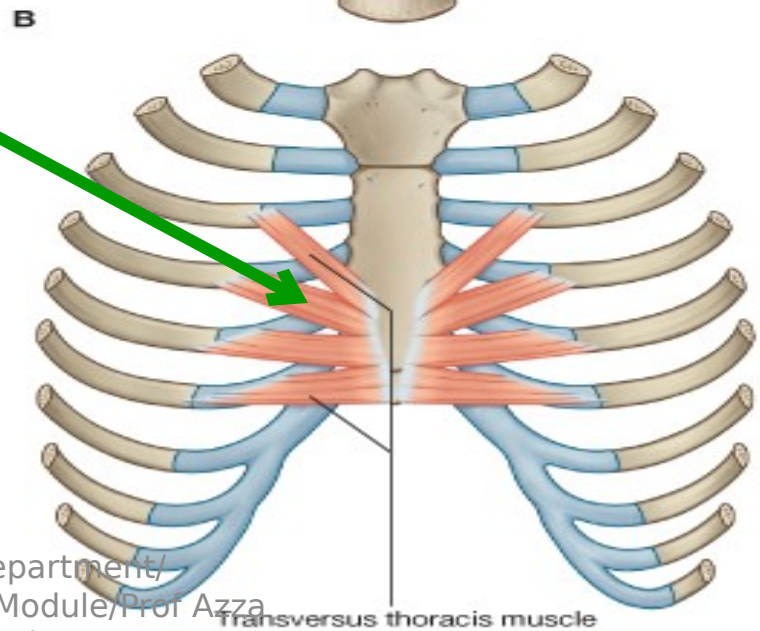
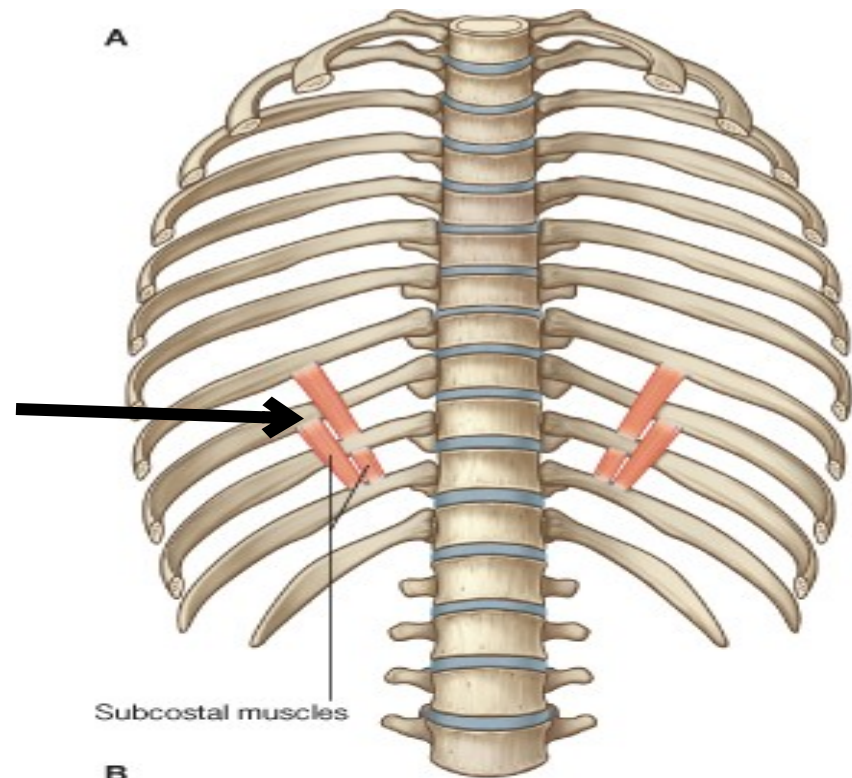
- **3 layers of flat muscles from outside inwards are :**

- 1. External intercostal**
- 2. Internal intercostal**
- 3. Incomplete layer formed of 3 muscles in innermost intercostal, subcostal, transversus**





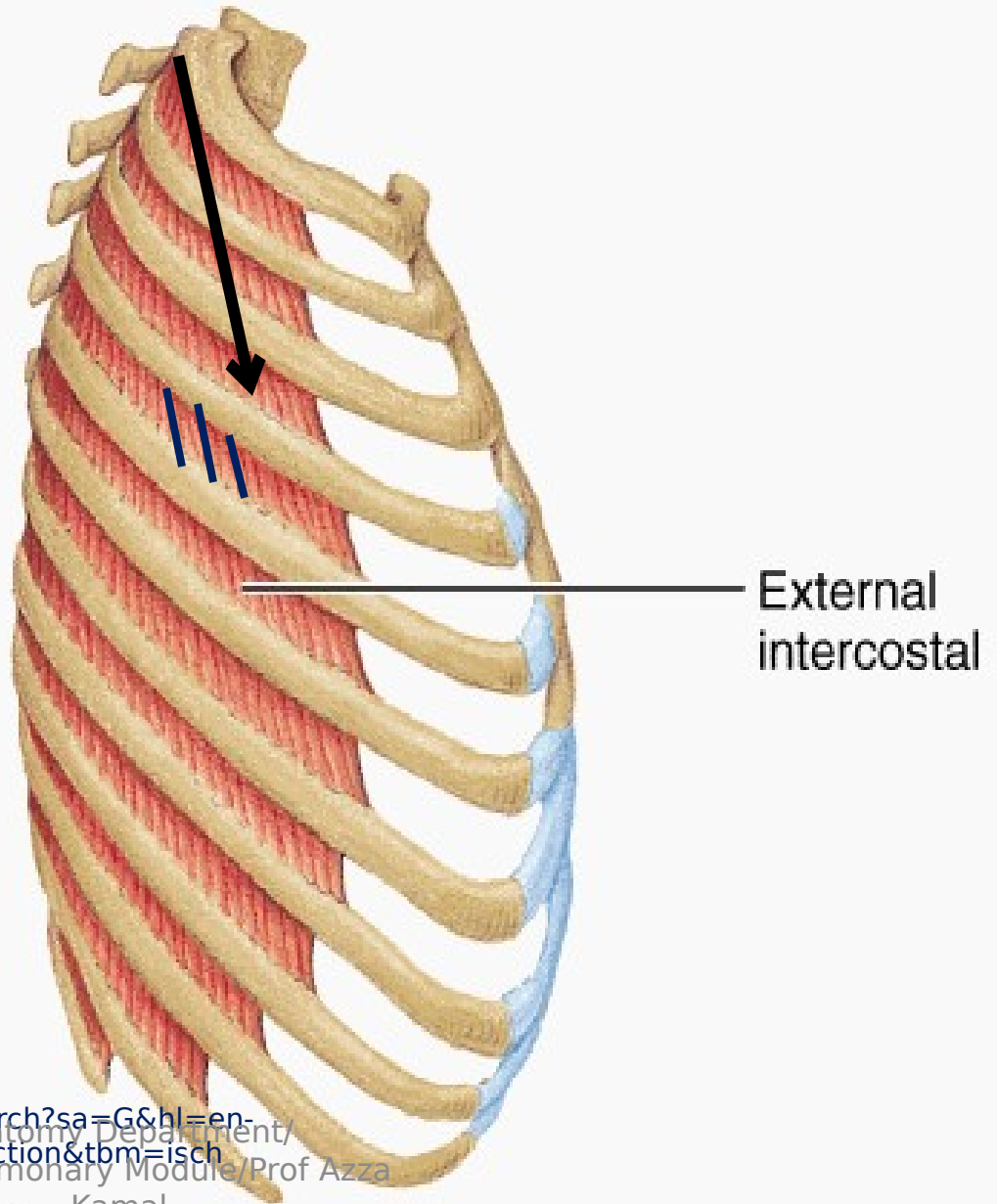
- **Subcostal and transversus thoracis muscles**





# External intercostal

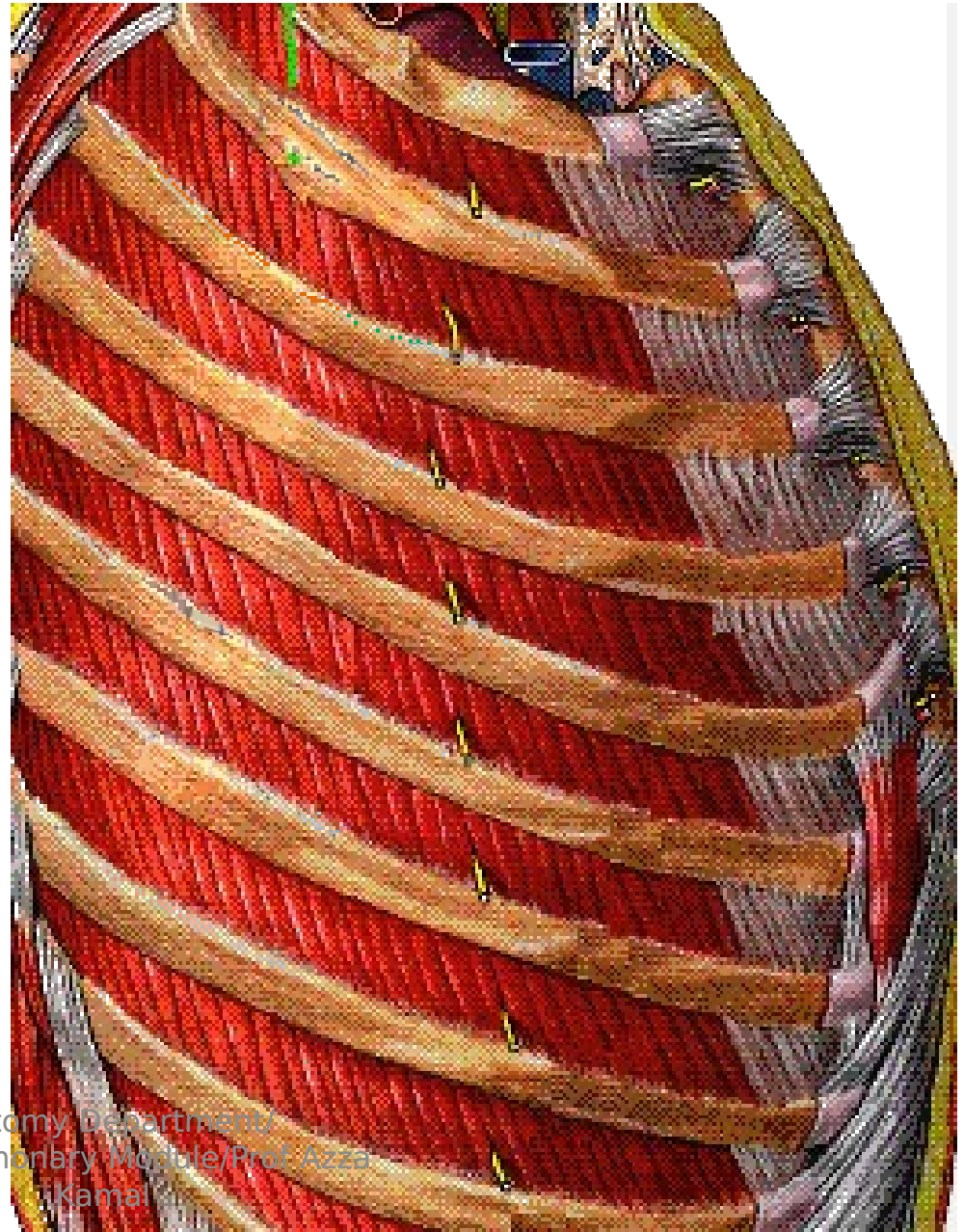
- **Fibers**   
**obliquel**  
**y**  
**downwa**  
**rds &**  
**forwards**



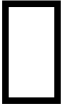
<https://www.google.com.eg/search?sa=G&hl=en-EG&q=internal+intercostals+action&tbn=isch>

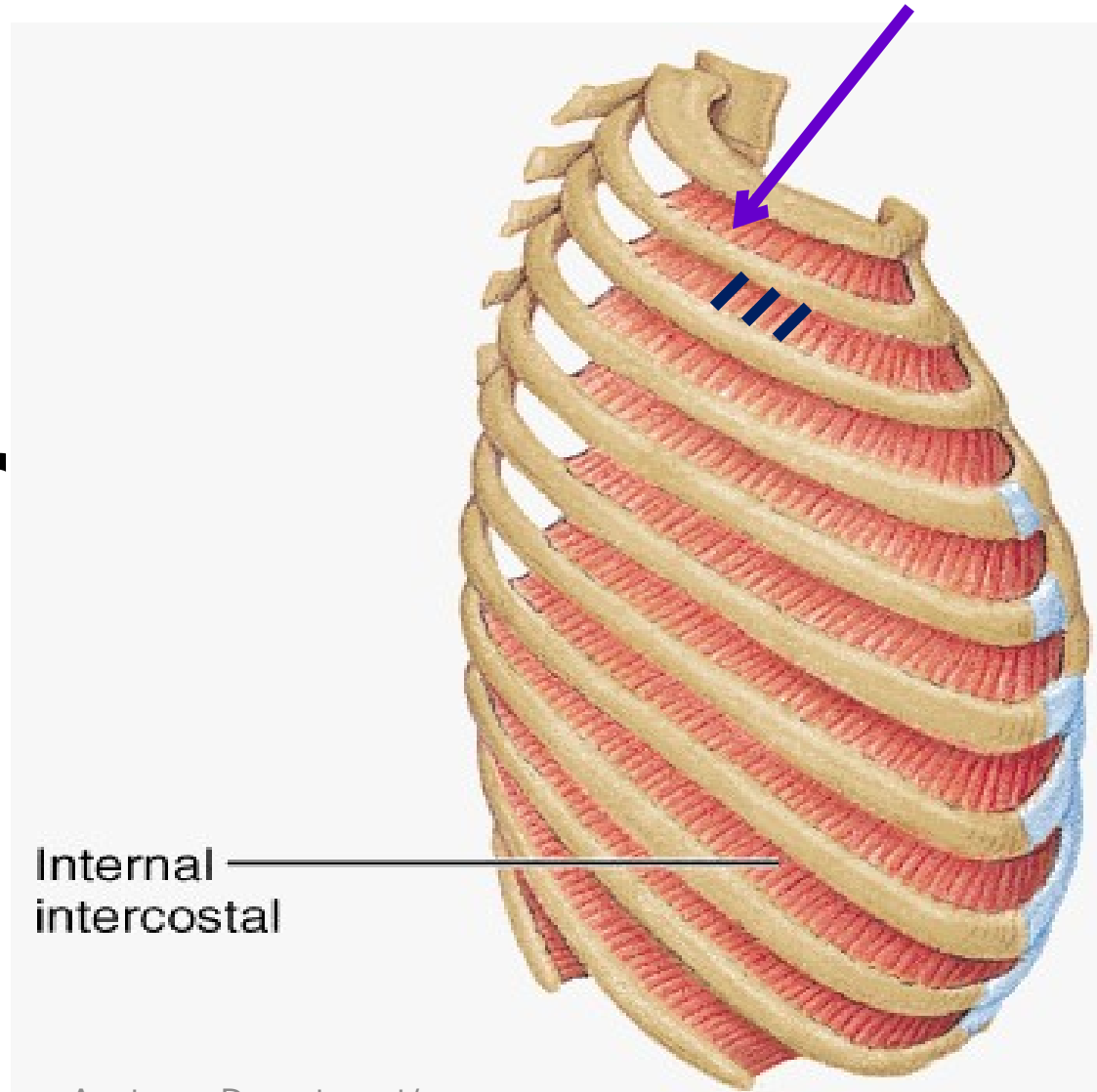
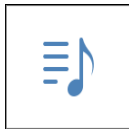
# External intercostal (cont)

- **Extent** from the tubercle of the rib posteriorly to the **junction of rib with its costal cartilage anteriorly** where it is **replaced by anterior intercostal membrane** which **extends to lateral margin of**



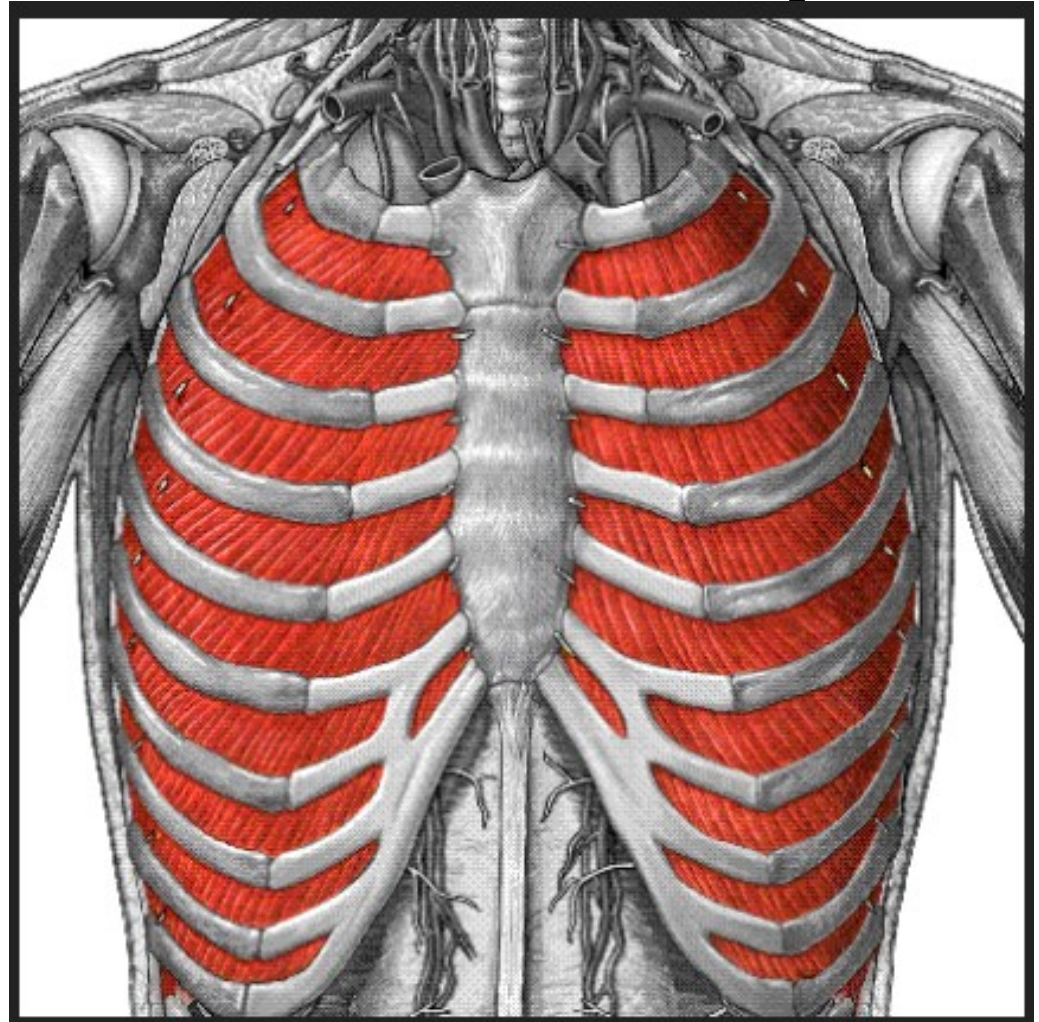
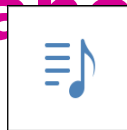
# Internal intercostal muscle

- **Fibers**   
**downwards &  
backwards**



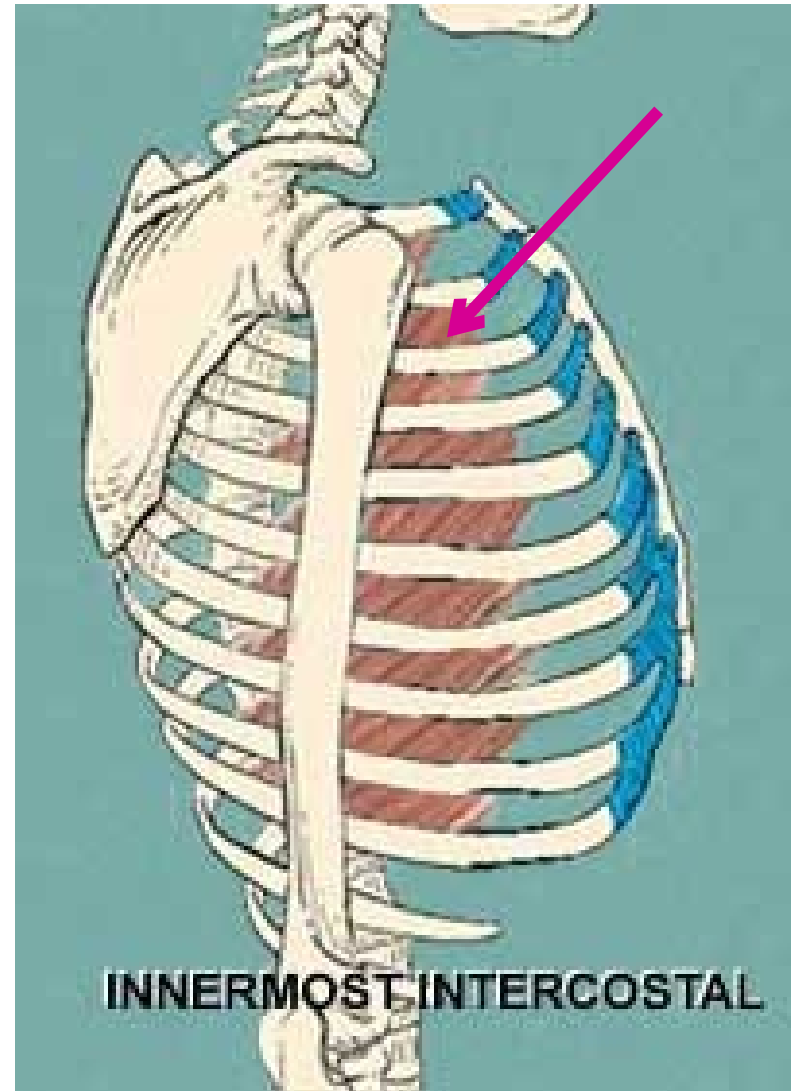
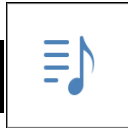
# Internal intercostal (cont)

- Begins from lateral margin of sternum anteriorly to angle of rib posteriorly where it is replaced by the **posterior intercostal membrane**



# Innermost intercostal

- It is a part of internal intercostal which is split off by the intercostal nerve & vessel



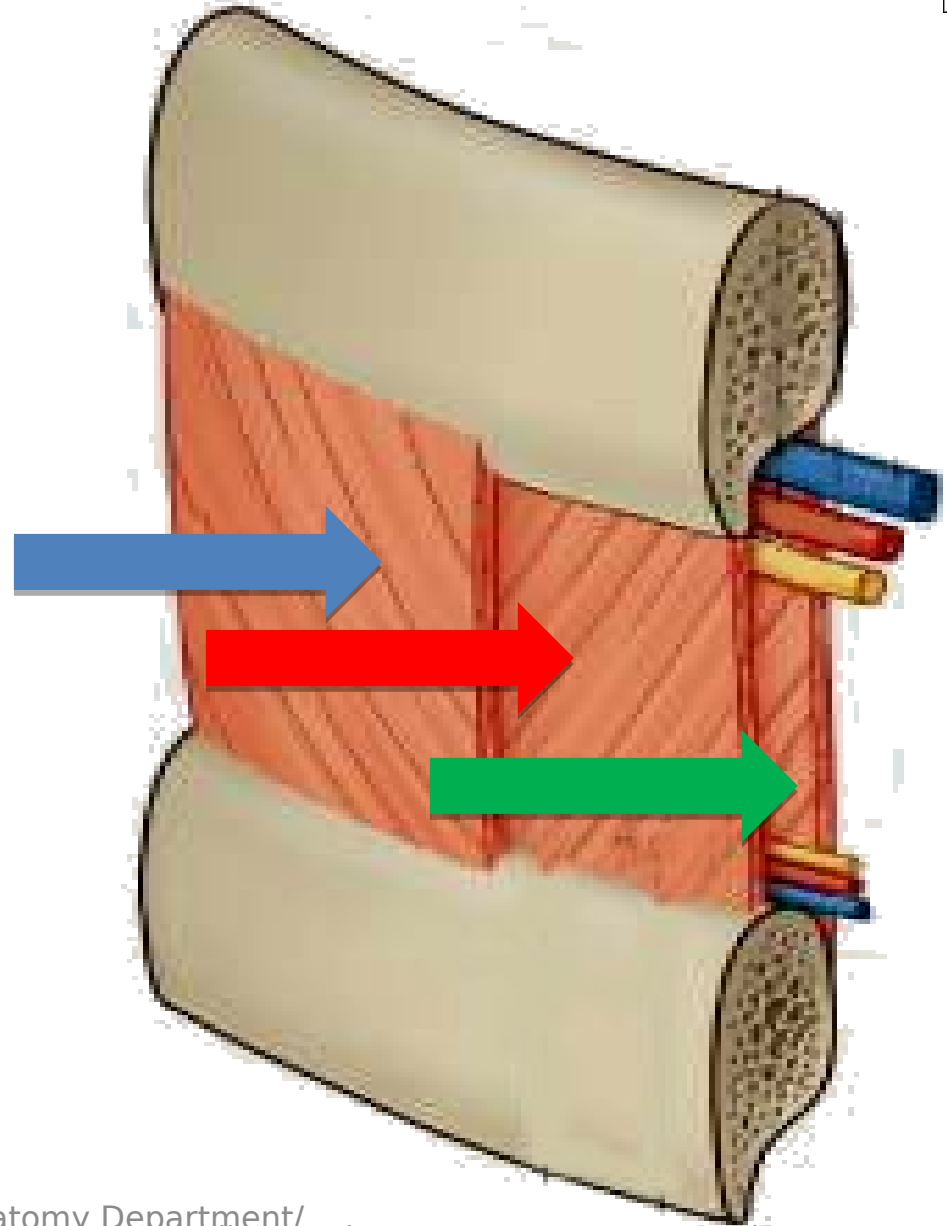




**External  
intercos  
tal**

**Internal  
intercos  
tal**

**Innermo  
st  
intercos  
tal**

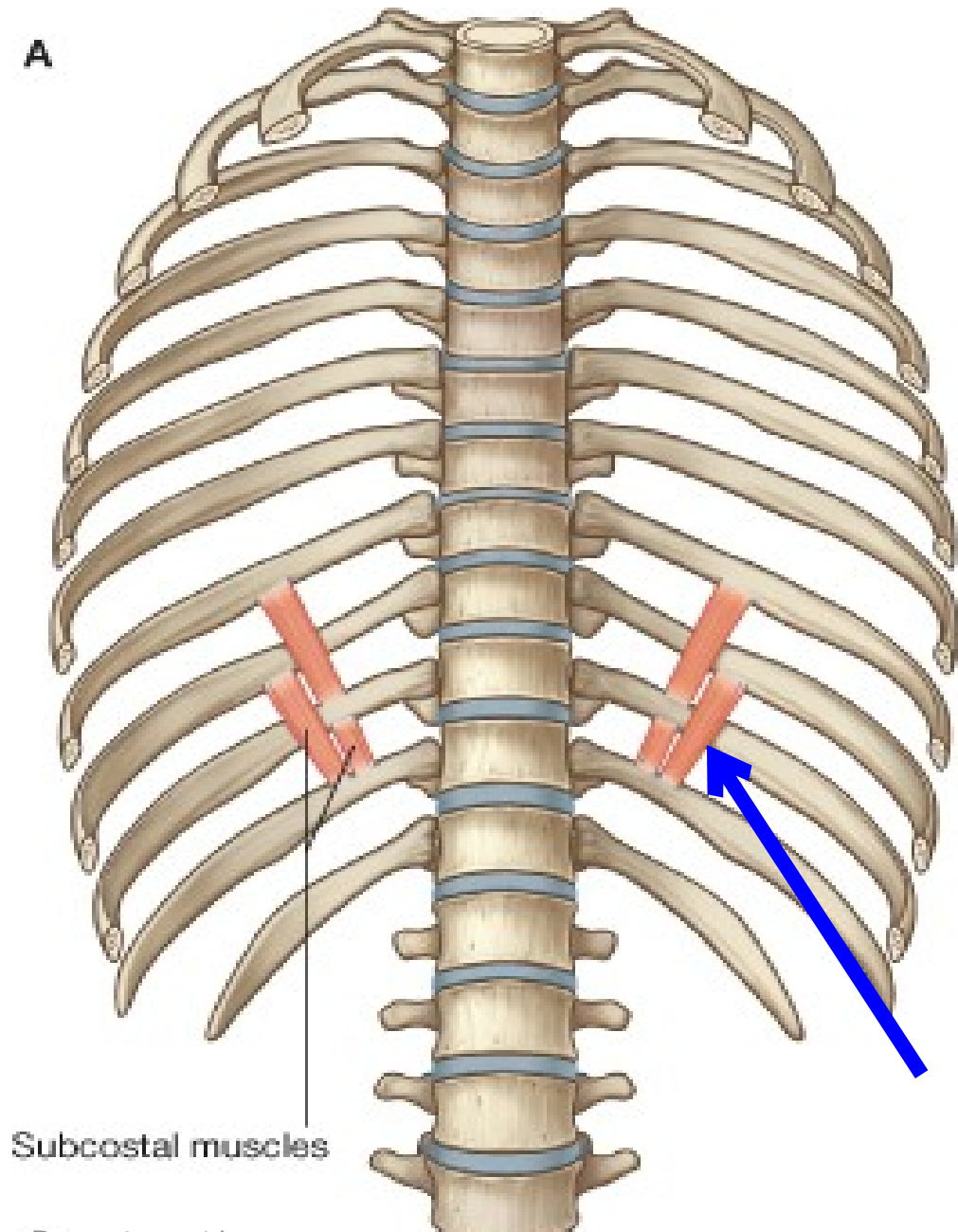


# Subcostal muscle

- Thin sheets of muscle fibers on inner aspect of internal intercostal
- Arises from one rib & crosses 2 or more intercostal spaces to insert in a rib below
- Maybe absent



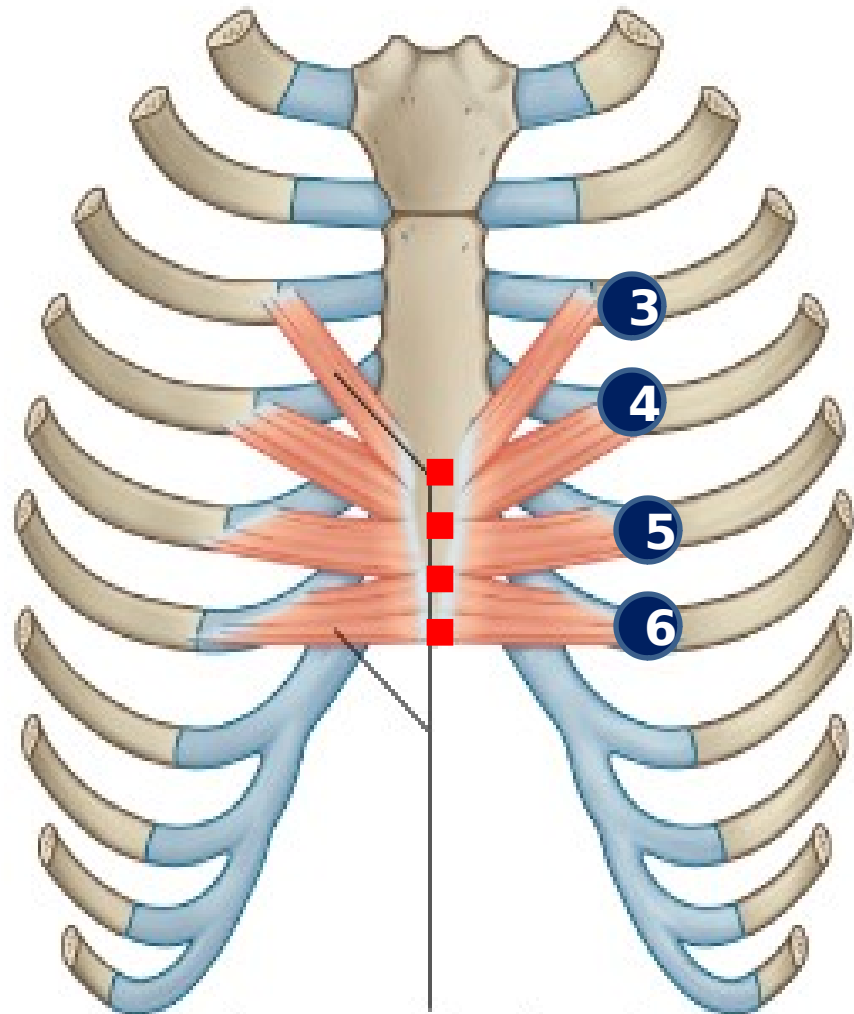
A



Subcostal muscles

# Transversus thoracis (sternocostalis)

- **Origin** ☐ lower third of back of sternum
- **Insertion** ☐ slips pass upwards & laterally to insert into 3<sup>rd</sup> to 6<sup>th</sup> cc



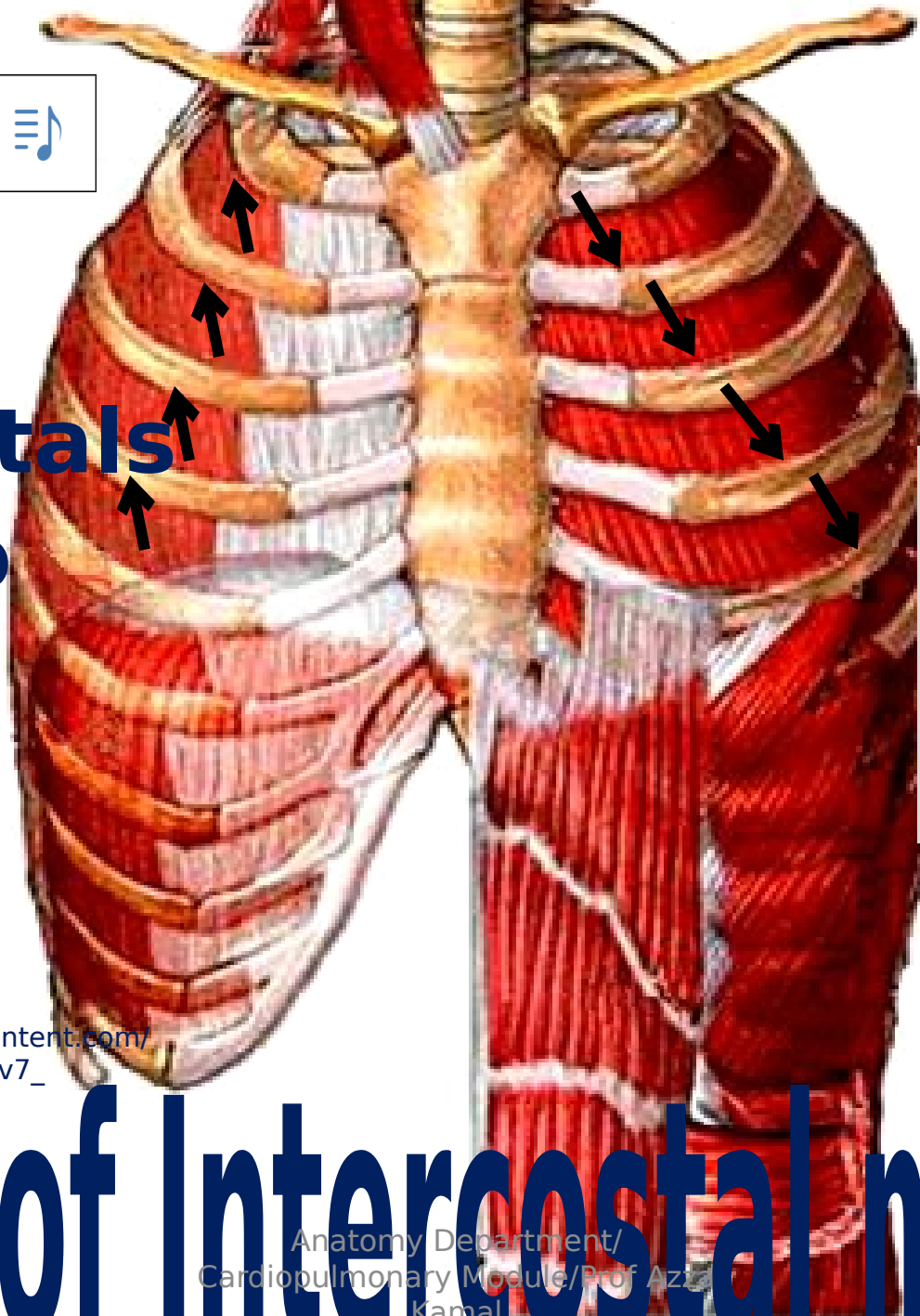
# Innervation of Intercostal Muscles

- All are supplied by the corresponding **intercostal nerves**





**External  
intercostals  
Elevato  
rs  
of the  
ribs**



**Internal  
intercost  
als  
Depress  
ors  
of the  
ribs**

[https://lh3.googleusercontent.com/\\_jycn0pVKphwyXGJ0Gt9v7\\_](https://lh3.googleusercontent.com/_jycn0pVKphwyXGJ0Gt9v7_)

# Action of Intercostal muscles

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# Function of intercostal muscles:

preventing them from being drawn in or out during respiration

2. **External intercostal** is most active in **inspiration** (elevators of the ribs).



3. **Internal intercostal & innermost intercostal ms** are most active in **expiration** (depressors of the ribs).

4. **Subcostal ms** depresses the ribs.

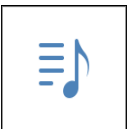
5. **Transversus thoracis** (sternocostalis)



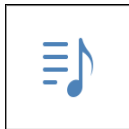
**Which of the following muscles is a rib elevator?**

- a) External intercostal**
- b) Internal intercostal**
- c) Innermost intercostal**
- d) Sternocostal**
- e) Transversus thoracis**

**MCQ tests the actions of intercostal muscles.**



# THANK YOU



***Suggested Textbook:***

*Clinical Anatomy for Medical Students*  
Richard S. Snell  
Pages 63-70

